

INTRODUCTION TO



# Custom Wind Solution Plc.



# EXTENDING WIND TURBINE BLADE LIFESPAN

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Routine inspections are essential to monitor the wear and tear of wind turbine components and reduce operating costs.

Blades exposed to environmental risks and events (rain, ice, lightning, birds, etc.) are among the most vulnerable components of wind turbines.

As blades get bigger and come faster on the market, their reliability is decreasing.

While wind turbines are designed to combat climate change, their ageing, broken blades pose a serious waste management problem. Turbine blades are made from fibreglass and non-recyclable resins, and have a planned life of around 25 years.

This may seem like a long time, but without proper maintenance their lifetime will be significantly shortened. It is therefore essential to extend the life of the blades through regular inspections and preventive maintenance.

The more wind farms are built, the greater and more pronounced this problem becomes.





# OUR SOLUTION

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Large or small projects, onshore or offshore wind farms, we offer a complex **Blade Inspection and Repair service package** to meet your needs.

**BiR** includes everything from full external and internal inspections to complex structural repairs.

As wind farms expand, blade inspection is becoming an integral part of prevention and maintenance.

Even the smallest surface defect on a blade can significantly reduce performance. ***Without the blades, there is no energy produced.***

Custom Wind Solution uses the most innovative cutting edge technologies to keep its services at a high level.

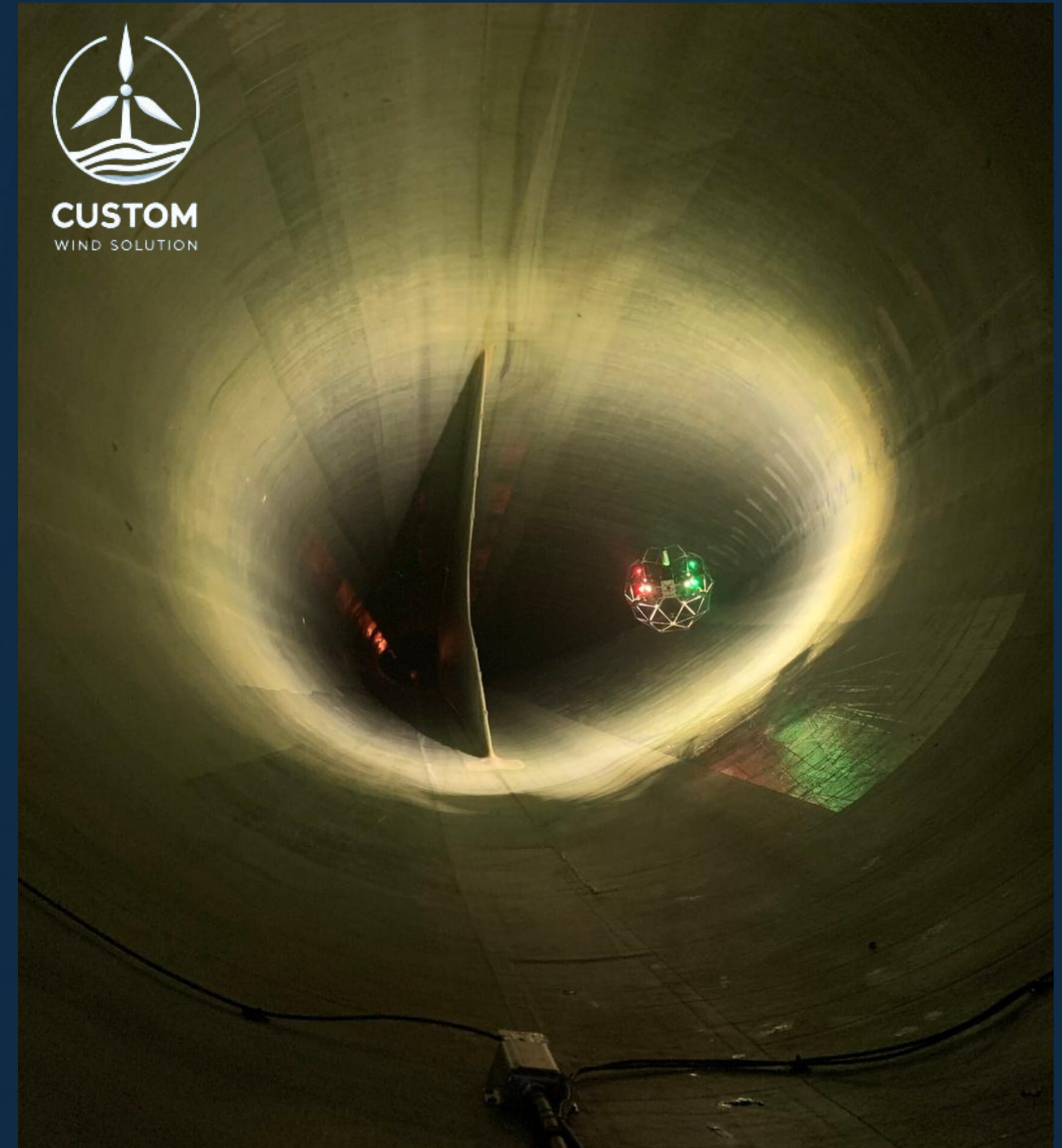
# BiR

- 1 Blade internal inspection
- 2 Blade external inspection
- 3 Lightning protection system inspection
- 4 Non-Destructive testing  
DFT ( Dry film tickness)
- 5 Sub-structural inspection by  
thermography
- 6 Blade repair services



# INTERNAL INSPECTION WITH DRONE

- Can go substantially further in the blade than a human
- Faster inspection than with a human - average 30 minutes/blade
- Blade does not need to be horizontal, so inspection can be done in 2 positions (time and cost saving)
- Safe - no man inside the blade
- High resolution images
- Improved anti-dust solutions - better image quality
- Fast evaluation
- Live stream available



# EXTERNAL INSPECTION WITH DRONE



Identification of **surface damages** on wind turbine blades through **HD images taken with a drone** provides an **exhaustive overview** of the blade condition, in order to plan your maintenance efficiently and without risks.

The inspections are **automatically compiled**, enabling more efficient image processing and better park maintenance management.

The images are then uploaded to our platform to generate reports automatically and facilitate **tracking of defects over time**.

Additionally, we are collaborating with our blade expert on an **AI system for automatic defect detection**

- 4-side inspection
- Autonomous flight or manual flight
- Quick inspection
  - 30 minutes/turbine for routine inspection
  - 45 minutes/turbine for deep inspection
- Inspection even without stopping the turbine
- Image stitching

# EXTERNAL INSPECTION WITH DRONE

## COMPATIBLE HARDWARE

**Drone:** Matrice 300, Dji  
**Camera:** Zenmuse P1, Dji  
**Sensor:** Pixels: 45MP (4,4  $\mu\text{m}$  / pixel)  
**Weight:** 800 g (camera) over 2,7kg of max payload  
**Accuracy:** Horizontal: 0.3 m, Vertical: 0.5 m

## FIELD OPERATION

**Number of machine stops:** 3 positions, blade upwards  
**Intervention time:** 30 minutes  
**Number of WTG per day:** Up to 10  
**Distance to the blade:** 4 to 5 meters  
**Weather:** Wind: < 13m/s, Rain: no; Visibility

## PROCESSING AND DELIVERABLE

**Data transfer:** .zip folder (log, mission report and images)  
**Assembly:** 4 sides of the three blades, with uploading to VisionAir  
**Annotations:** Done by the client (expertise available upon request)  
**Delivery (duration):** 2 weeks



# LIGHTNING PROTECTION SYSTEM INSPECTION

## Closed circuit

- measurement of the circuit resistance

## Volta Station

- ohmmeter, winches (2x150m), control panel

## Generator

- isolate the measuring system from the system to be measured

## Human resources

- pilot, wind turbine technician

The remote pilot controls a **drone equipped with the Volta accessory**, which is connected to an electric cable of 150m long which makes the link between the receptor and the ohmmeter. A second winch makes the link between the ohmmeter and the ground of the wind turbine. The drone is driven so that the probe comes in contact with the receptor: a closed circuit is created and we obtain the **measurement of resistance of the circuit**.

A **photo of the state of the receptor** is also taken during the intervention via the camera of the drone. The intervention requires **3 machine stops, blade at 6 o'clock**.



# LIGHTNING PROTECTION SYSTEM INSPECTION

## SYSTEM CHARACTERISTICS

Measurement method: 2-wire measurement

System resistance: 8.221  $\Omega$

Reliability: 10 measurements per second

Accuracy: 0.1 $\Omega$

Certification: patented in France

## FIELD OPERATIONS

Number of WTG stops: 3 WTG stops, Y configuration

Intervention time: 30min to 1h depending on operational conditions

Number of measurements / receptors: up to 10 per receptor

Number of WTG / day: up to 10

Protocol 1 – Classic: receptor - Ground

Protocol 2 - Gap Nacelle: receptor - hub/nacel - Ground

## CONDITION OF USE

Weather: wind: < 13m/s ; rain: no ; visibility

Inspection of TIP receptor: yes

Inspection of sunk receptor: yes

REPORT DELIVERY: 2 weeks

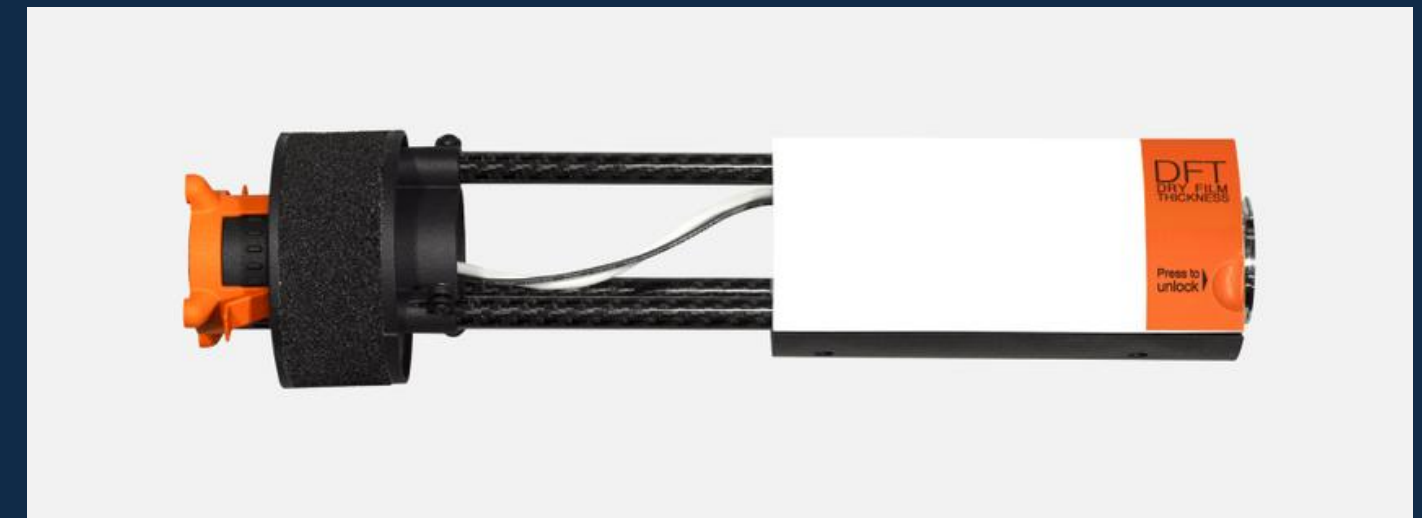


# NON-DESTRUCTIVE TESTING – DFT

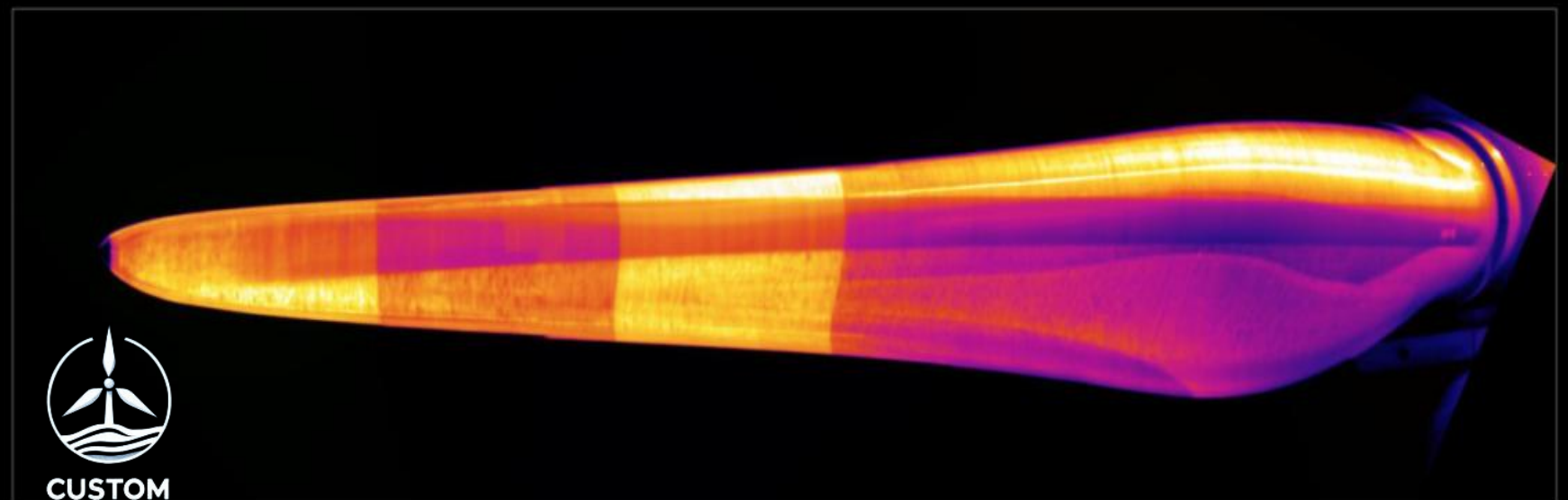
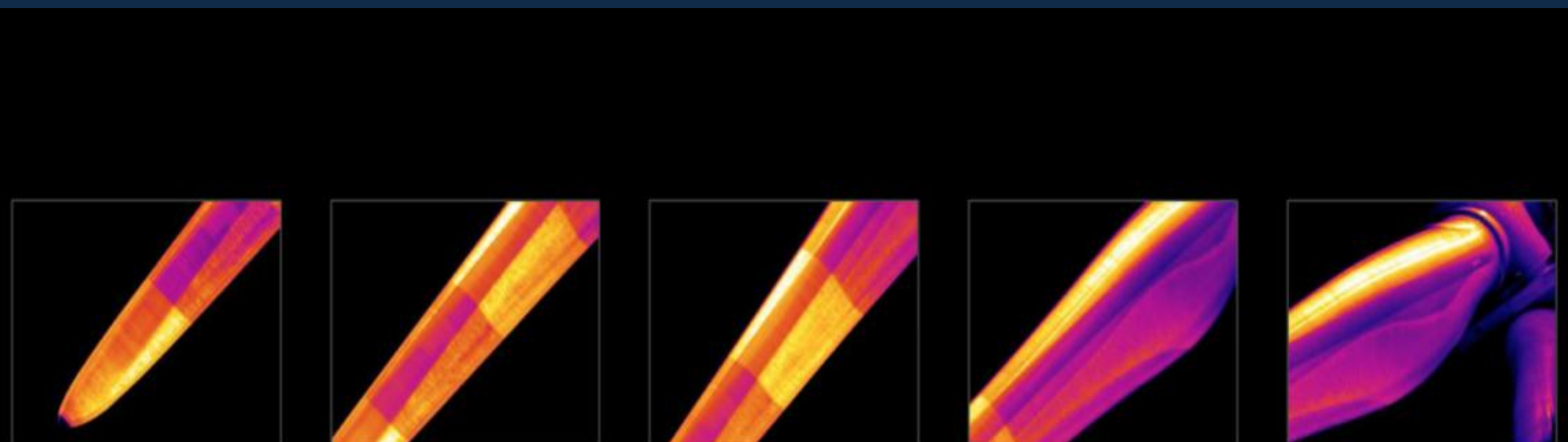
## DFT ( Dry Film Thickness ) testing on tower by drone

- Magnetic induction and eddy current measurement mode
- Welding testing
- Coating thickness testing
- Corrosion testing
- Download the completed report and customize to your needs
- Feed the data into your own reporting of digital twin software
- High resolution camera inspection is also available for external or internal inspection of the tower

When equipped with another instrument, drone is suitable for the instrumental inspection of cracks in **concrete and hybrid towers**.



# SUB-STRUCTURAL INSPECTION BY THERMOGRAPHY



Thermography is a **non-destructive measurement technique** used to highlight **internal anomalies**: using a thermal camera, these areas appear as hot or cold spots due to **temperature contrast with healthy regions**. In the case of passive thermography, we utilize the **sun** as the heat source.

The drone equipped with a camera that has **three sensors**: two visible sensors (wide-angle and zoom) and one thermal sensor.

The blade is positioned so that it is **perpendicular to the incident sunlight** and is heated for 15 minutes.

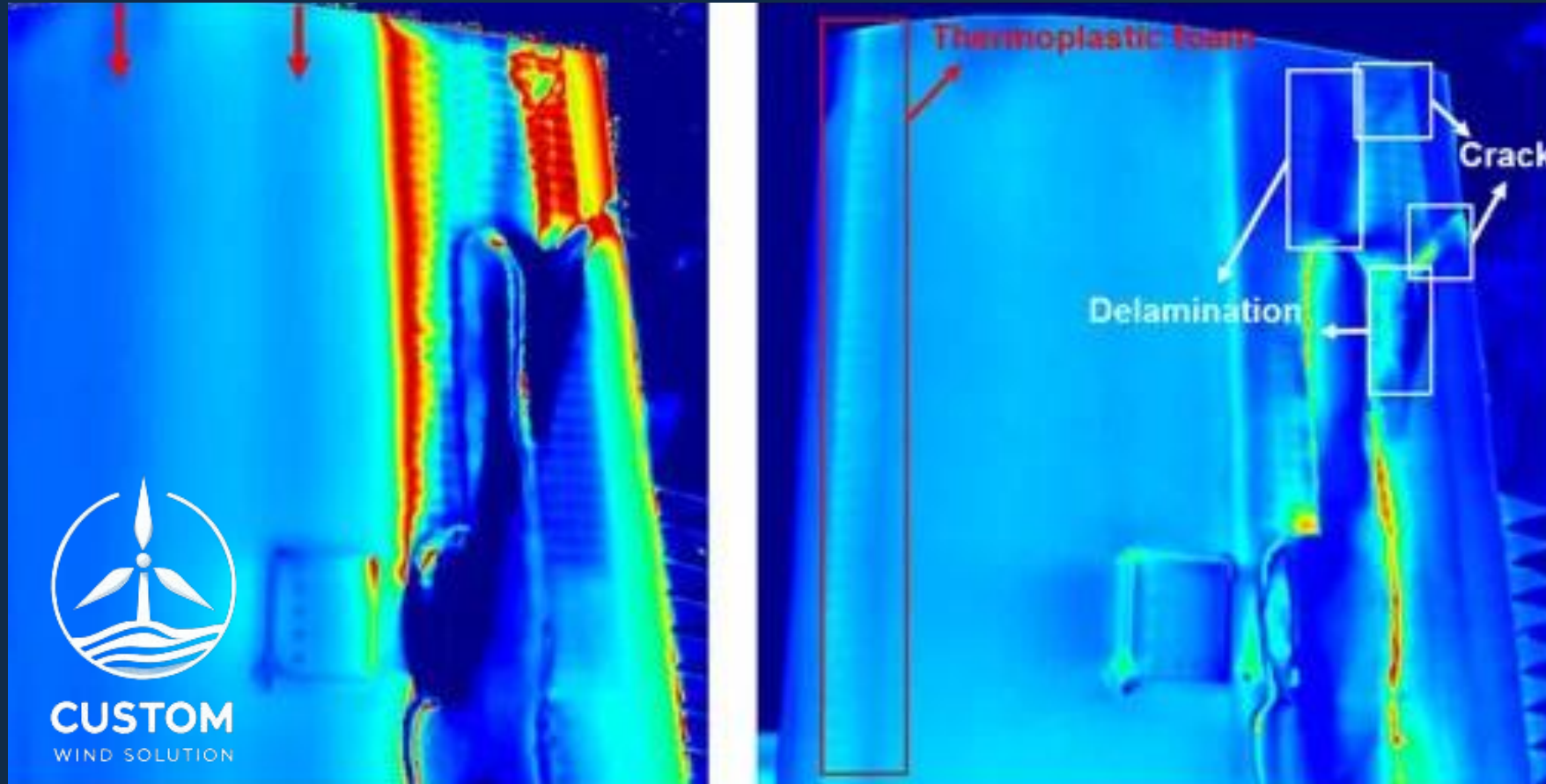
Once the heating time is reached, the blade is **scanned** using the drone and its onboard camera. The images are post-processed to enhance the contrast of defects and then analyzed by our thermal experts.

- 1 mm accuracy to detect the most subtle defects
- 20-25% of LCOE = maintenance costs (O&M)
- Detection of substructure defects invisible in the visible spectrum.
- Ideal for end of warranty inspections
- 25% of O&M costs are related to blade maintenance.

Defect repair costs are reduced by 4% when the defect is properly identified and qualified. Continuous cyclic mechanical stress: each structural failure amplifies these stresses.

# WHAT WE CAN PERCEIVE

## Detectable internal anomalies



### Dry zone

Manufacturing defect causing a change in thermal properties: the zone lacks the composite properties but only has those of the fiberglass since the resin was not properly injected in this area.

### Wrinkle

Manufacturing defect causing a change in thermal properties: multiple layers of fiberglass overlap, and the resin has been displaced.

### Water Infiltration

Following an impact in the balsa zone, water infiltration may occur, leading to a weakening of the overall blade structure.

### Delamination

Local detachment of fiberglass layers due to aging. This often leads to a through-thickness crack.

## Act early: plan for early repairs!

- The intervention requires **between 3 and 6 machine stops**, depending on the inspection time and weather conditions.
- **Intervention time:** 1h30 to 2h (depending on operational conditions)
- **Weather:** Wind <7m/s ; total radiation: 700W/m<sup>2</sup> ; visibility
- **Report delivery:** 2 weeks

# PROCESSING DATA



## BLADE DIGITALIZATION

Visualize and annotate your blades and towers on an ergonomic platform and obtain personalized reports in white label. The navigation is easy to use which allows you not to miss anything and save time.

## FOLLOW-UP OF DEFECTS OVER TIME

Follow the condition of your blades over time by linking defects from one inspection to another: assess their evolution and plan your maintenance as well as possible.

## EFFICIENT DATA MANAGEMENT

Annotate your blades or towers 50% faster than on a photo gallery and see at a glance which wind turbines need repair by filtering the defects you want to see in the report.

## EASY INTERFACING

Interface VisionAir to your software using our API (programming interface) and access your data on all your management tools (CMMS).

## FEATURES

Annotation: by our blade and tower expert or by your experts on VisionAir

Digitization: automated assembly of blades and towers

Defect tracking over time: ability to link defects to past inspections

Programming interface (API): yes, with possible interfacing (CMMS)

KPI follow-ups: yes, by level of criticality

## REPORT

Report generation: automated and instantaneous

Report customization: yes

Customizable defect grid: yes



# BLADE REPAIR SERVICES

With the help of our Rope Access team, we can undertake the professional repair of any damage or defects found.

As always, our focus is on safety, quality, flexibility and the right people with the right skills.

Combined with our vast experience, this makes us the **ideal partner** for blade repair and service.

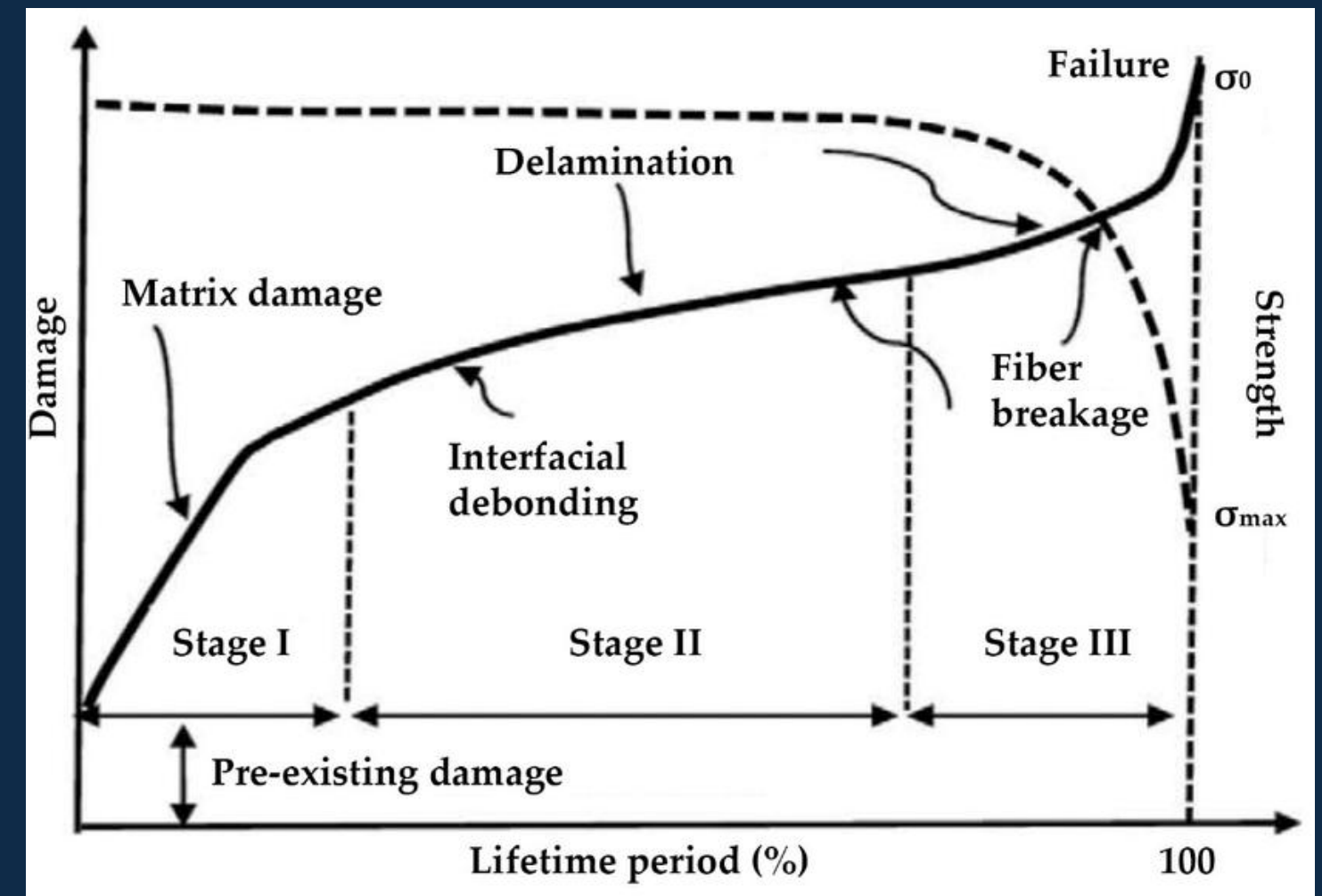


# WHAT ELSE WE CAN OFFER



Underlying data is the key to good decision-making. Our aim is to provide you with relevant and concrete information on the condition of your blades and recommendations on what should and can be done.

- We are able to provide technicians to stop-start, lock and secure the turbine for most of the turbine types.
- Most of our drone pilots has blade repair experience and knowledge wich help to identify the anomalies in realtime.
- Our blade department has technicians for all types of blade access and the back office to support both small and large projects and campaigns.
- Act quickly and decisively on critical damages to keep turbines running
- The complete package or any of its **components can be ordered separately.**
- **One purchase order** number is enough when ordering multiple service items.



# LET'S WORK TOGETHER TO EXTEND THE LIFE OF YOUR BLADES!



## Custom Wind Solution Plc.



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